



FAA-E-2581
AMENDMENT-1
January 7, 1976

DEPARTMENT OF TRANSPORTATION FEDERAL AVIATION ADMINISTRATION SPECIFICATION

ASR-4B, 5, 6 RADAR IMPROVEMENTS

This amendment forms a part of FAA-E-2581 dated January 7, 1974.

Page 1, paragraph 1.1, delete in its entirety and replace with the following:

"1.1 Scope.- This specification sets forth the requirements for an ASR-4B/5/6 improvement package. The contractor shall be responsible for:

- (1) The design, testing, production and installation of a receiver RF front end including antenna beam switch, RF gain, STC circuitry, and control system.
- (2) The design, testing, production and installation of a Range Gate Generator (RGG) to be used in conjunction with the antenna beam switch and (STC).

The ASR-8 antenna's dual drive system offers increased reliability. The dual beam antenna will allow improved low angle coverage and a reduction in clutter."

Page 2, paragraph 2.1, add the following after FAA-G-2100/4b:

"FAA-G-2100/5a, Part 5, Requirements for Equipment Employing Integrated Circuit Devices."

Page 3, first line, delete in its entirety and substitute the following: "FAA Order 6310.2, Maintenance of Airport Surveillance".

Page 3, paragraph 3.1, delete in its entirety and replace with the following:

"3.1 General requirements.- The Airport Surveillance Radar (ASR) systems in which the improvement package specified herein will be installed are designated the ASR-4, ASR-5, or ASR-6. These systems, nearly identical in nature, are described in the applicable instruction manuals. Prior to the time of installation of the improvement package specified herein, each system will have been modified by installation of an ASR-8 antenna as specified in FAA-E-2506 and described in the ASR-8 instruction manuals. The Government will select and provide access to one of its low density sites for a preliminary survey of the system modification. The location selected shall take into consideration the prospective bidder's location. The Government will not provide radar downtime or allow the contractor to control or adjust any portion of the radar. Visits to the operational sites will be limited and strictly controlled by the Contracting Officer or his Technical Representative. At installation time the Government will provide radar downtime for the system modification. This downtime will be kept to an absolute minimum and scheduled for the least active time so as to minimize the impact on air traffic control. The FAA will determine when the required shutdown may occur, so as to have the least impact on control of air traffic."

Page 4, paragraph 3.2.1, delete the following items from the list of deliverable items: (d), (e), (f), (g), (h), (i), (j) and (k). Delete "(b)" in its entirety and replace with the following: "(b) 2 each Range Gate Generators (RGG) (3.15 and subparagraphs)."

Page 5, paragraph 3.2.2, delete the following line item, "(a)", "(b)", "(c)", "(d)", "(e)", "(f)", "(g)", "(h)" and "(n)".

Page 6, paragraph 3.3.1, delete the following from the first sentence: ", excluding monitor PPI and TR limiter,". In the second sentence, place a period after "5000 hours" and delete the remainder of the sentence.

Page 7, paragraph 3.5, first line, delete "maintenance monitor CRT," and the "comma" after "TR limiter."

Page 8, paragraph 3.5.6, delete in its entirety.

Page 9, paragraph 3.5.8.2, lines 15 and 16, delete the following, "(1 through 51)."

Page 9, paragraph 3.5.8.4.1, add the following to the list of items:

"(d) Blanks for insertion of measured data and allowed tolerances."

Page 10, paragraph 3.6, delete in its entirety and substitute the following:

"3.6 Installation.- One each dual channel kit shall be installed and tested by the contractor at a site designated by the Government. The contractor shall remove all unnecessary units, assemblies, wiring, components, connectors, markings, and miscellaneous hardware that are no longer required in the existing system as a result of the modification. The installation shall be planned and executed in such a manner that the total radar downtime for the channel being modified is held to a minimum. At no time during the modification shall it become necessary to interfere with the operation of the radiating channel. Only one radar channel shall be modified at a time, i.e., completely modified and tests satisfactorily completed so that channel is acceptable for air traffic control. Only then will the second channel be removed from service for modification by the contractor. At the discretion of the Government, the contractor shall be required to perform the installation during non-peak air traffic periods. Tests shall be performed as required by Section 4 herein."

Page 10, paragraphs 3.6.1 and 3.6.2, delete in their entirety.

Page 10, paragraphs 3.6.2.1 and 3.6.2.2, delete in their entirety.

Page 10, paragraph 3.6.2.3, delete in its entirety.

Page 10, Paragraph 3.6.2.4, delete in its entirety.

Page 11, paragraph 3.6.3, delete the last two lines.

Page 11, paragraph 3.7, in the first line change "3.8" to "3.14." and add the following: "The resulting modified installation shall meet all specification requirements set forth herein, and shall not degrade the performance of the system throughout the range of service conditions specified for the equipment being modified."

Pages 11, 12, and 13, paragraph 3.8 and subparagraphs thereto, delete in their entirety.

Pages 13, 14 and 15, paragraph 3.9 and subparagraphs thereto, delete in their entirety.

Page 15, paragraph 3.10, delete in its entirety.

Page 16, paragraph 3.11, delete in its entirety.

Page 16, paragraph 3.12, delete in its entirety.

Page 16, paragraph 3.13, delete in its entirety.

Pages 16, 17, and 18, paragraphs 3.14 through 3.14.5, delete in their entirety. Also delete paragraph 3.14.7. Add the following:

"3.14 Receiver gain control/STC/antenna beam selector.- Receiver RF gain, sensitivity time control (STC), and antenna pattern selection (main or passive) shall be accomplished by means of PIN modulators inserted in the two receive paths between the TR device (3.17.4) and the parametric amplifier. When biased for minimum attenuation, the resultant insertion loss of the PIN modulators in each receive path shall be as required to insure that the RF loss of the added components shall not exceed the RF losses of the deleted components. When biased for maximum attenuation, the characteristics of the PIN devices shall be as required to provide the receiver RF gain, STC, and beam isolation functions specified below. Separate and independent STC and receiver gain functions shall be provided in both the high beam (passive) and low beam (main) receive paths for each channel. A signal input of +30 dBm cw or less shall not damage the device under any combination of attenuations and service conditions.

3.14.1 Receiver RF gain.- PIN modulator bias control circuitry shall be provided to independently control the attenuation of the high (passive) and low (main) receive paths in five discrete, preset steps. Remote selection of any one of the five pairs of preset attenuation levels shall be provided. Each bias level shall be adjustable by means of maintenance controls to provide RF attenuation ranging from the minimum insertion loss of the PIN device up to 60 dB. The preset level shall remain constant within + 0.75 dB over the range of service conditions. This variation shall not add to the minimum insertion loss specified in 3.14.

3.14.2 Sensitivity time control (STC).- Separate STC control circuitry shall be provided for each receive path. Each STC circuit, by control of the PIN device bias, shall provide three time varying gain characteristics (STC-1, STC-2 and STC-3). Any of these three pairs of characteristics, as well as an STC OFF, shall be remotely selectable. The STC characteristics shall be generated digitally. The range clock from the Range Gate Generator (RGG) shall be utilized to clock the STC units. The range accuracy at 60 miles shall be $\pm .1$ mile. The digital to analog conversion shall be accomplished in the STC chassis.

The three STC characteristics shall be generated by three identical, separately adjustable circuits with minimum range of adjustment as follows:

- (a) The initial value of receiver attenuation shall be adjustable from the minimum insertion loss of the device to at least 60 dB.
- (b) The start of the exponential decrease in attenuation from the initial value shall be adjustable from a minimum of not more than one microsecond after the beginning of the transmitted pulse to at least 300 microseconds.
- (c) The shape of the attenuation curve shall be adjustable from a characteristic which is inversely proportional to the first power of range to a characteristic which is inversely proportional to the fourth power of range. The maximum attenuation need not exceed the 60 dB level specified above.

The selected STC characteristic shall be combined with the selected preset attenuation level described herein (3.14.1). The STC characteristic and the fixed attenuation level shall be additively combined in such a manner that the shape of the STC curve is unaffected by the amount of fixed attenuation selected; provided, however, that the maximum STC depth need not exceed 60 dB and resultant flattening of the start of the curve is permissible. It shall be possible to extend the STC recovery point 60 to 360 microseconds after start of exponential decrease while meeting all of the other characteristics specified above.

The overall STC attenuation characteristics shall be accurate within $\pm .75$ dB for attenuations up to 15 dB and $\pm 5\%$ for attenuations above 15 dB for all signal inputs of -20 dBm and below and over the entire range of service conditions. This variation shall not add to the minimum insertion loss specified in 3.14.

3.14.3 Antenna pattern selection.- The antenna pattern selection function shall be accomplished by biasing the PIN modulators (3.14) to act as a single-pole-double-throw switch; i.e., one modulator is biased "off" while the other is biased "on", with provisions to reverse the states simultaneously. The output of the "on" modulator shall be routed to the parametric amplifier input by means of a waveguide Tee or similar device. Switching point in radar range

where the switching from one feed path to the other takes place will be determined by the antenna pattern selector (paragraph 3.14.4). The actual switching time, including that part contributed by the antenna pattern selector and its associated drive circuitry, shall be 100 ns maximum. The amount of jitter during the actual switching process contributed by the antenna pattern RF switch and the antenna pattern selector and associated drive circuitry shall be sufficiently small that the MTI performance is not degraded. The RF gain/STC functions shall not be adversely affected by the antenna pattern selection function; nor shall the insertion loss of the PIN modulator which is biased "on" be increased above the level specified in 3.14. The isolation between the two receive paths shall be not less than 30 dB; i.e., the signal level from the "off" path shall be at least 30 dB below the signal level from the "on" path as seen at the input to the parametric amplifier. This isolation requirement applies for all possible combinations of RF attenuations and STC settings of the "on" path.

3.14.4 Antenna pattern selector.- The antenna pattern selector shall initiate the switching action of the antenna pattern RF switch. The point in radar range where this switching action is initiated shall be determined by one of the following selectable sources:

- (a) An internal switch designated high beam/low beam which will select either the energy received from the passive feed horn (high beam) or the energy received from the main feed horn (low beam).
- (b) An internal generated gate that is adjustable from 0 to 60 miles in range, to switch from the high beam to the low beam."

Page 18, paragraph 3.15, delete in its entirety, and substitute the following:

"3.15 Range Gate Generator (RGG).- A dual channel RGG unit shall be provided to drive all range requirements of this specification. The RGG channel in use shall be determined by the selection of the active radar channel."

Page 18, paragraph 3.15.1, delete in its entirety, and substitute the following:

"3.15.1 Range Gate Generator synchronization.- Range dependent functions of the RGG shall be synchronous with zero range. A range counter shall be provided and clocked by a very stable, high frequency, crystal controlled source. The range counter shall be capable of being reset to zero range. The least significant bit of the range counter shall be 1/16 nautical mile or less; the maximum count shall be at least equivalent to the range from zero range to 60 nautical miles after zero range. Frequency and stability of the range counter shall be as required to ensure system performance in accordance with all specified requirements herein and all present operational parameters."

Page 19 and 20, paragraphs 3.15.2 through 3.15.5, delete in their entirety.

Pages 20 and 21, delete paragraphs 3.16 through 3.16.5 in their entirety.

Page 22, paragraph 3.17, delete in its entirety and substitute the following:

"3.17 Waveguide system.- The contractor shall provide an additional waveguide run between the equipment and the high beam port of the rotary joint. The existing low beam waveguide run shall be modified as required to interface with the modification kit."

Pages 23, 24, and 25, paragraph 3.18 and subparagraphs thereto, delete in their entirety.

Page 26, paragraph 3.19.1, delete items (1) through (5) and substitute the following:

"(1) IAGC on/off	1	Not Removed.
(2) Normal FTC 1/2/off	2	Not Removed.
(3) MTI FTC 1/2/off	2	Not Removed.
(4) Integrated MTI/NOR on/off	1	Not Removed.
(5) Integrated NOR on/off	1	Not Removed."

Page 26, paragraph 3.19.1.1, delete line four and substitute the following:

"controls are IAGC on/off, Normal FTC 1/2/off, MTI FTC 1/2/off, Integrated MTI/NOR on/off, Integrated NOR on/off, and Integrated Video Gate".

Page 28, paragraph 3.19.4.1, change "nearly" to "nearby".

Pages 28 and 29, paragraph 3.19.5, delete the following items in their entirety, "(3), (4), (7), (19), (20), and (22)."

Page 30, paragraph 3.19.7, delete the following: "(1)" and "(2)". Delete line seven and substitute the following: "The total size of the above panels shall not exceed a "J" size per Speci-".

Page 30, paragraph 3.20, first sentence only, delete and substitute the following: "Beam switching circuitry, RGG unit, and STC/RF Gain circuitry shall be located in a separate cabinet in the radar building. Drawers, panels, etc., shall be designed to fit a standard 19" wide rack."

Page 31, paragraph 3.20.5, delete the last sentence.

Page 35, paragraphs 3.20.7.12 and 3.20.7.13, delete in their entirety.

Page 36, paragraph 3.20.7.14, delete the last line and substitute, "Specification FAA-G-2100/1, /3, /4, and /5."

Page 37, paragraph 4.3, delete the third and fourth sentences.

Page 38, paragraph 4.6, delete lines 9 through 18, and substitute the following:

- "S Receiver gain/STC (3.14)
- S Antenna pattern selector (3.14.4)
- S RGG Performance (3.15)
- S,V Power supply performance (3.20)
- S Control system (3.19)
- S Meter readings (3.20.8.2)
- S Beam switching (3.14.3)"

Page 38, paragraph 4.7, delete the first line and substitute, "4.7 Kit proofing.- Field tests shall be performed on each kit after".

Page 39, paragraph 4.7.2, in line "(h)" delete "(Normal and MTI)" and add "(Normal, MTI and STC Curves)". In the third line, delete "Handbook SM P 6310." and substitute "Order 6310.2." Also, delete items "(l), (m), and (n)."

Page 40, paragraph 4.7.4, add the following:

"The following tests will be performed in accordance with FAA approved test procedures."

Page 40, paragraph 4.7.4.1, delete item "(h)".

Pages 40 and 41, paragraph 4.7.4.2, delete the following items, "(n), (g), (s), (t), (u), (v), and (l)." Add the following item, "(g) RGG performance (3.15 and 3.15.1)". In addition add to item (h) "(3.17.4)", add to item q "3.14.3 and 3.14.4".

Page 41, delete the last paragraph and substitute the following:

"As a minimum the post-installation test data shall equal or exceed the pre-installation data.

Field tests shall be performed by the contractor on each radar channel when installation is complete on each channel and then system tests shall be performed when both channels are complete. Each channel shall operate under test conditions for at least 36 hours and the system must operate under test conditions for at least 24 hours after the tests on the individual channels are completed. Test data shall be recorded at least every six hours during the test. Any observation of malfunction or instability shall be recorded in the test log. The Government representative(s) shall be permitted to make any number of entries into the log even if not concurred in by the contractor's representative. In the event of failure in the radar system unrelated to the contractor's modification, the test time shall be extended by a time equal to the outage. All specification requirements shall be met during the tests without readjustment of any controls. The radar channel/system shall operate for the entire test period without relevant failure due to any portion of the system furnished, modified, or installed by the contractor. In case of a failure of any portion of the system furnished, modified, or installed by the contractor, the test shall be restarted from zero time after repair is accomplished."

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